

**DESCRIPTION OF THE PUPAE OF THREE SPECIES OF THE GENUS
LUTZIA, A COMPARISON OF NEW AND OLD WORLD PUPAE, AND A KEY
TO PUPAE AND LARVAE OF THE GENUS (DIPTERA: CULICIDAE)**

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Abstract.—The pupae of *Lutzia bigoti* (Bellardi) and *Lt. allostigma* (Howard et al.) from Central America and *Lt. tigripes* (De Grandpre and De Charmoy) from Africa and western Asia, are described. Comparison is made between New World and Old World species. Marked differences are noted in the shape of the trumpet and paddle, in the reticulation of the intersegmental membranes, and in some elements of chaetotaxy. Keys to *Lutzia* pupae and larvae are given.

Key Words: *Lutzia*, Old World, New World, keys, pupae, larvae

The genus *Lutzia* Theobald is a small genus with only seven species. Tanaka (2003) made significant changes in *Lutzia*. It was originally described as a genus by Theobald (1903) but reduced to a subgenus of *Culex* by Edwards (1932). Now it is elevated again to generic rank by Tanaka. He also created three new subgenera, i.e., *Metalutzia* Tanaka for the Asian, African and Australasian species, the monotypic subgenus *Insulalutzia* Tanaka for *Lt. shinonagai* Tanaka, Mizusawa and Saugstad, while the subgenus *Lutzia* Theobald applies to the two Neotropical species. He likewise removed *Lt. vorax* (Edwards) from synonymy with *Lt. halifaxii* Theobald. All these changes were based on the morphology of the pupa.

Lutzia is unique among the Culicini by having predaceous larvae. Even though there are few species, they are distributed on all continents (Edwards 1941, Knight and Stone 1977, Tanaka et al. 1979, Belkin 1962). I have had the opportunity to study the pupal stage of two species from the New World (Central America), *Lutzia bigoti* (Bellardi) (Clark-Gil and Darsie 1983)

and *Lutzia allostigma* (Howard et al.) (Heinemann and Belkin 1977, 1978) and the Old World species, *Lutzia tigripes* (De Grandpre and De Charmoy). Also, I compared the New World with the Old World pupae, including *Lutzia fuscana* (Wiedemann) and *Lutzia halifaxii* (Theobald) pupae from Nepal (Darsie and Pradhan 1990), the same species from the Ruykyu Archipelago (Toma and Miyagi 1986) and the description of the pupae of *Lt. shinonagai* and *Lt. vorax* (Tanaka 2003).

Lutzia bigoti pupa was partially described and illustrated by Lane (1953), while pupae of *Lt. allostigma* is described here for the first time. The two Old World species, *Lt. fuscana* and *Lt. halifaxii* were described and illustrated by Toma and Miyagi (1986). Otherwise, the trumpet, abdominal segments VII, VIII and paddle of the *Lt. fuscana* pupa were figured and partially described by Delfinado (1966). The pupa of *Lt. halifaxii*, perhaps the most widely distributed of the *Lutzia* species (Knight and Stone 1977), has been described several times but without the usual table of pupal chaetotaxy and/or complete

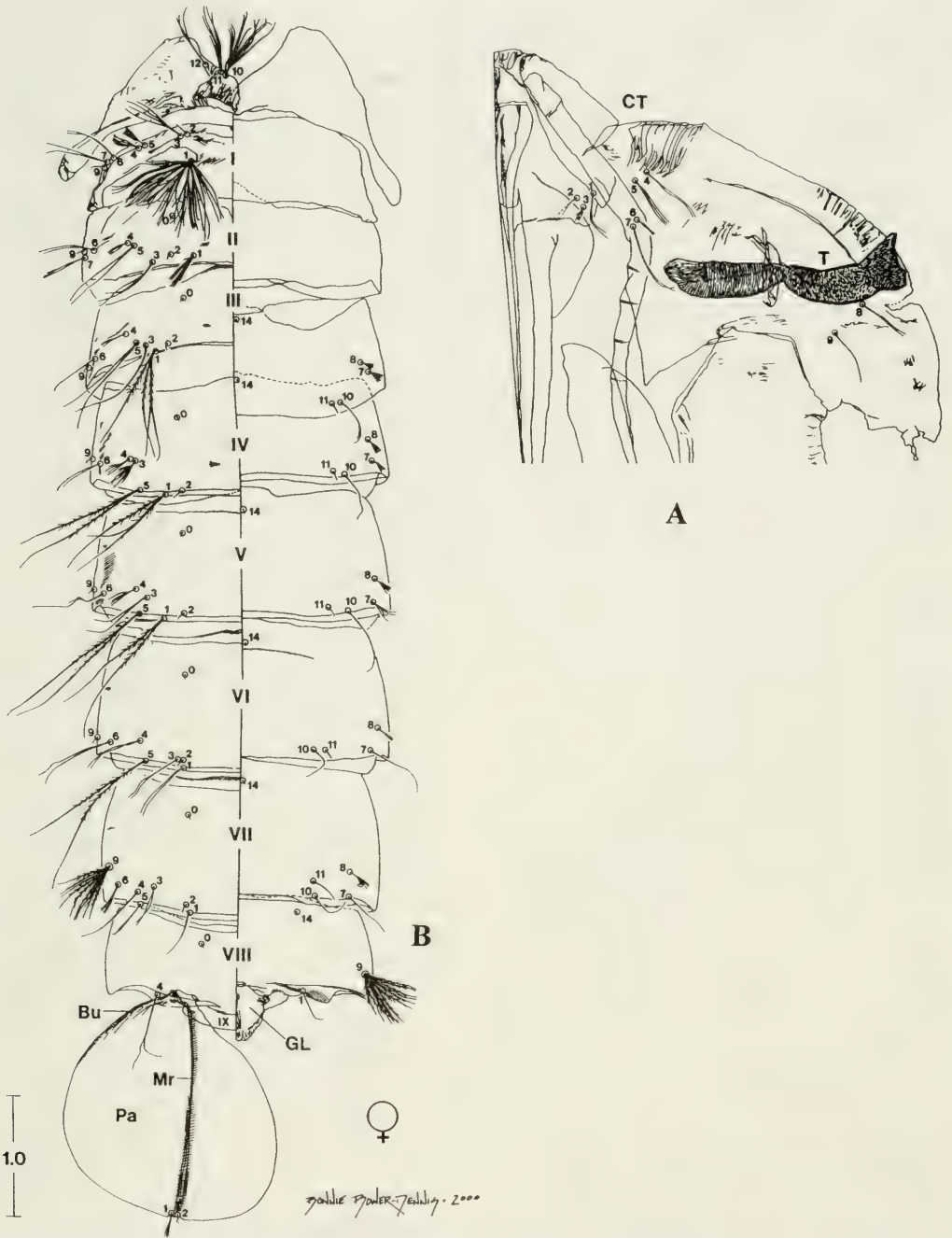


Fig. 1. Pupa of *Lutzia bigoti*. A, Cephalothorax. B, Metanotum and abdomen, dorsal left, ventral right. Bu = external buttress of paddle, CT = cephalothorax, GL—genital lobe, Mr = midrib of paddle, Pa—paddle.

CT long, 1,3-CT single or double; 5-CT double to quadruple; 7-CT usually double; 6-CT short, single, seldom double; 8,9-CT moderately long, single, rarely double; 10-

CT moderately long, with 8–12 br; 11,12-CT long, usually double. *Trumpet*: Dark brown, reticulate, except for basal 0.22–0.30, \bar{x} 0.26 dark tracheoid stripes, flared

apically; length 0.98–1.35, \bar{x} 1.22 mm, index 3.6–5.3, \bar{x} 4.4 *Abdomen*: Light brown, except dark brown in middle 0.5 of I–IV and intersegmental membranes of abdominal segments II–IV without reticulations, length 6.24–7.44, \bar{x} 6.83 mm, setae 0–II–VIII, 9–I–VI, 14–III–VIII minute, single; setae 2–II–VIII, 11–III–VII short, single; seta 1–I dendritic, with 6–10 primary br, seta 1–II and VII moderately long, with 10–19 br on II and single on VII, setae 1–III, V, VI, long, 1–III stout, aciculate, with 2–4 br; 1–V, VI single or double, seldom triple, 1–IV very long, double, seldom single, 1 absent on IX; seta 3–I–III long to very long, single to triple, 3–IV moderately long, usually with 6–8 br, 3–V–VII long, single or double; seta 4–I–V short, 4–I with 5–8 br, 4–II–V with 3–6 br, 4–VI–VIII long, single to triple; seta 5–I short, with 5–8 br, 5–II, III long, double; 5–IV–VI very long, stout, aciculate, double, seldom single; 5–VII moderately long, single or double; seta 6–I–VI long, single or double, rarely triple, 6–VII short, with 3–5 br; seta 7–I, II long, double, seldom single or triple, 7–III–V short, with 2–7 br, 7–VI, VII long, single, rarely double; seta 8–III–VII short, with 4–7 br on III, single to 5 br on IV–VII; seta 9–VII, VIII long, stout, aciculate, with 6–10 br on VII, 9–13 br on VIII. Seta 10–III, IV medium long, usually double, seldom single or triple, 10–V–VII long, single, rarely double. *Paddle*: Ovoid, light tan, not emarginate apically, length 1.67–1.98, \bar{x} 1.83 mm, index 1.04–1.33, \bar{x} 1.13; margin smooth, midrib reaching to apex, seta 1, 2–P short, 1–P single to quadruple, 2–P single, seldom double.

Specimens studied are as follows: Guatemala, Central America: Guatemala City, VIII-21-80, 3 ♀ Pe, 1 ♂ LePe; VIII-24-80, 2 ♀, 1 ♂ LePe, ex artificial container (S. Clark-Gil).

Description of the Pupa of

Lutzia allostigma

(Fig. 2)

The range and modal number of branches are in Table 2. *Cephalothorax*: Light

brown, scutum darker; setae 1,3,4,7–9–CT long, single or double, seldom triple; 6–CT short, single or double; 10–12–CT long, 10–CT usually 8- or 9-branched; 11–CT stout, double; 12–CT mostly double, seldom single or triple. *Trumpet*: Medium brown, reticulate, except for small patch of tracheoid, 0.11–0.21 mm subbasally; length 0.95–1.45, \bar{x} 1.22 mm, index 3.39–5.37, \bar{x} 4.69. *Abdomen*: Light brown, darker on segments II–III, intersegmental membranes of II–IV without reticulations, length 5.73–7.42, \bar{x} 6.33 mm, setae 0–II–VIII, 9–I–VI, 13–III–VIII minute, single; setae 2–II–VII, 11–III–VII short, single; seta 1–I dendritic with 6–15 primary br, 1–II and VI, VII short to moderately long, with 6–15 br on II, single to triple, rarely 5-branched on VI, single on VII; 1–III–V very long, rather stout, single or double, 1–IX absent; seta 3–I–III long to very long, with extra adventitious setae in one instance, single or double, rarely triple, except in one specimen where 3–III long, stout, double on one side and medium long, 6-branched on the other, 3–IV short, usually 6-branched, 3–V–VII long, single rarely double; seta 4–I short, with 4–8 br, 4–II, III and VI–VII long, single or double, 4–IV–V medium long, triple or quadruple, seldom double; seta 5–I short, with 2–7 br, 5–II, III short, usually double to quadruple, 5–IV–VI very long, stout, aciculate, single or double, 5–VII medium long, single; setae 6–I–VI long to very long, single or double, 6–VII short, usually 4–6 br; seta 7–I, II long, double, seldom triple, 7–III–V short, usually with 3–6 br, 7–VI, VII long, single; setae 8–III–VII short, with 2–6 br; setae 9–VII, VIII long, stout, aciculate, with 3–5 br on VII, 4–9 br on VIII; seta 10–III, IV long, single or double, 10–V–VII long, single; 11–III–VII short, double or triple, rarely single; 12–I very long, usually double, seldom single or triple. *Paddle*: Ovoid, light tan, not emarginate apically, length 1.63–1.92, \bar{x} 1.74 mm, index 1.04–1.39, \bar{x} 1.17; margin smooth, midrib reaching near to apex, seta 1–P short, single, seldom double or triple, 2–P short, single, rarely double.

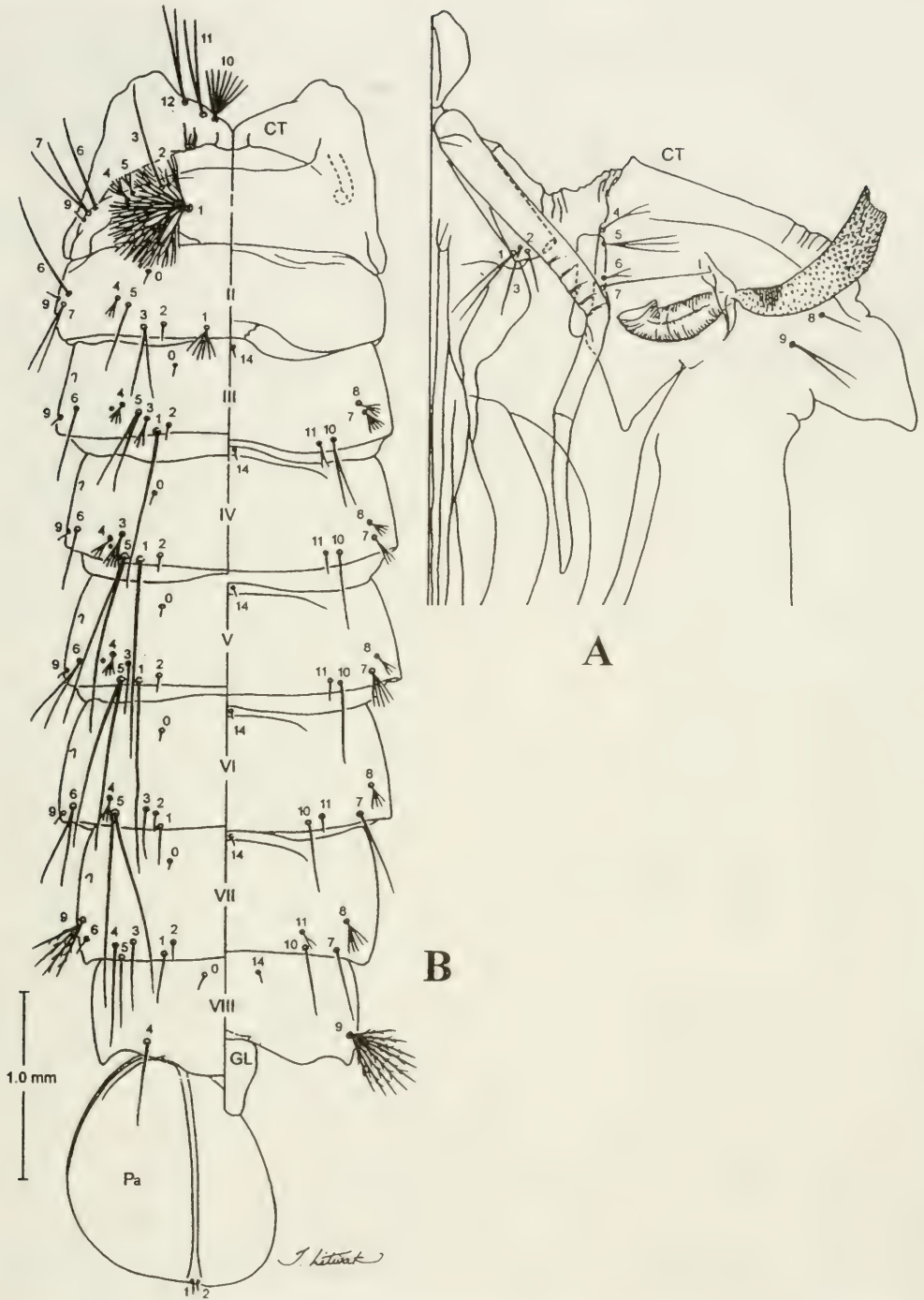


Fig. 2. Pupa of *Lutzia allostigma*. A, Cephalothorax. B, Metanotum and abdomen. CT = cephalothorax, GL = genital lobe, Pa = paddle.

Table 2. Setal branching of the pupa of *Lutzia allostigma*. Range followed in parenthesis by modal numbers.

Seta	Abdominal segments										Paddle			
	Cephalothorax	I	II	III	IV	V	VI	VII	VIII					
0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	1, 2 (2)	6-15 (?)	1	1, 2 (2)	1	1, 2 (1)	1	1	1	1	1	1	1	1-3 (1)
2	1, 2 (2)	1-3 (2)	2	1	1, 2 (1)	1, 2 (1)	1	1	1	1	1	1	1	1, 2 (1)
3	1, 2 (1)	2, 3 (2)	1	1-6 (2)	4-7 (6)	1, 2 (1)	1	1	1	1	1	1	1	—
4	1, 2 (1)	3-8 (5, 6)	2	2-4 (3)	2-4 (4)	2-4 (4)	1	1	1	1	1	1	1	—
5	1, 2 (2)	2-7 (2, 3)	2-5 (2)	2, 3 (2)	2-3 (2)	1, 2 (2)	1	1	1	1	1	1	1	—
6	1, 2 (2)	1	1, 2 (2)	1, 2 (2)	1, 2 (2)	1, 2 (1)	1	1	1	1	1	1	1	—
7	1, 2 (2)	2, 3 (2)	4-10 (6)	3-5 (3)	1-6 (1)	1-6 (1)	1	1	1	1	1	1	1	—
8	1, 2 (1)	—	4-6 (5)	3-5 (3)	2-5 (3)	2-5 (3)	1	1	1	1	1	1	1	—
9	1, 2 (2)	2-4 (2, 3)	1	1	1	1	1	1	1	1	1	1	1	—
10	6-11 (8)	—	1, 2 (2)	1, 2 (1)	1, 2 (1)	1-3 (2)	1	1	1	1	1	1	1	—
11	2	—	2, 3 (2)	1-3 (2)	1-3 (2)	1-3 (2)	1	1	1	1	1	1	1	—
12	1-3 (2)	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Specimens studied are as follows: Costa Rica, Heredia, Puerto Viejo, Finca La Selva, VIII-7-71, 1 ♀, 2 ♂, LePe ex natural containers (A. Berrios Arias); Panama, Darien, Puerto, Rio Pucro, II-24-64, 1 ♀, 1 ♂, LePe ; ex rockhole (A. Quinonez).

Description of the Pupa of *Lutzia trigrupes* (Fig. 3)

Range and modal number of branches in Table 3. *Cephalothorax*: Light brown, darker posteriorly on scutum, setae 1, 3-5, 7-9-CT long, 2-CT moderately long, 6-CT short, all single, 10-CT long, with 4-6 br, 11,12-CT long, single; *Trumpet*: Medium brown, reticulate except for small tracheoid patch measuring 0.15-0.22 subbasally, length 1.01-1.25, \bar{x} 1.11 mm, index 2.88-4.31, \bar{x} 3.64, pinna 0.4-0.53, \bar{x} 0.45 mm. *Abdomen*: Light brown, darker on II-III, intersegmental membranes II-III and III-IV reticulate medially; length 5.05-6.59, \bar{x} 5.72 mm; setae 0-II-IX, 9-II-VI, 14-III-VIII minute, single, seta 2-I-VII, 11-III-VII short, single; seta 1-I dendritic, with 7,8 primary branches, 1-II short, pedunculate, usually 4 br (3-6), 1-III-VII long, 1-III usually 6-8, seldom 9-11 br, 1-IV usually 4, 5 br, seldom triple or 6 br, 1-V-VI single to triple, 1-VII single; seta 1-IX present; seta 3-I-III long, stout, single or double, 3-IV,VI-VIII long, IV with 4-6 br, 1-VI,VIII single, 3-V moderately long, double to quadruple; seta 4-I short, usually with 4 br (3-7), 4-II-V,VII long, 4-II,IV,V,VII single or double, 4-III with 3-5 br, seldom double, 4-VI moderately long, single or double; seta 5-I-III short, 5-I,II single to triple, 5-III double to quadruple, seldom with 5 br, 5-IV-VII long, 5-IV with 3-5 br, 5-V-VII single or double, rarely triple; seta 6-I-VI long, 6-I,VI stout, single or double, 6-II-V single, rarely double, 6-VII moderately long, with 2-4 br, seldom single; seta 7-I very long, single, seldom double or triple, 7-II,VI,VII long, single or double, 7-III,V short, usually 4-6 br, seldom double or with 7 br, 7-IV moderately long, single to triple, seldom quadruple; seta 8-III-VII

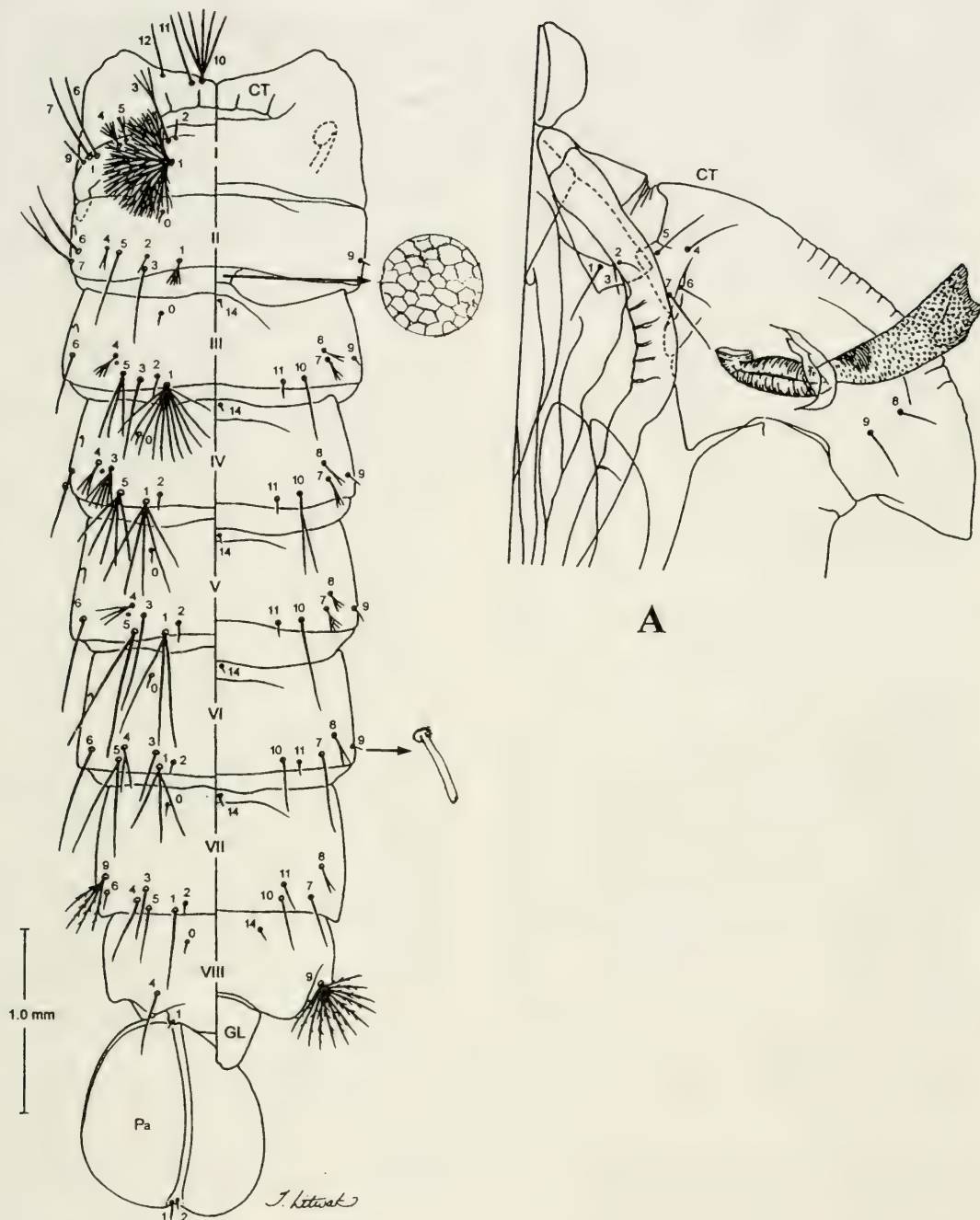


Fig. 3. Pupa of *Lutzia tigripes*. A, Cephalothorax. B, Metanotum and abdomen. CT = cephalothorax, GL = genital lobe, Pa. = paddle.

short to moderately long, 8-III,IV usually with 3-6 br, V-VII usually single to triple, seldom with 4-6 br; seta 9-VII, VIII long, stout, aciculate, 9-VII usually with 3-6,

rarely 7 br, 9-VIII usually 8-10 br, seldom 7 or 11-16 br. *Paddle*: Ovoid, margin smooth, midrib not reaching apex, length 1.19-1.54, \bar{x} 1.37 mm, index 1.03-1.26, \bar{x}

Table 3. Setal branching of the pupa of *Lutzia trigripes*. Range is followed in parenthesis by model numbers.

Seta	Abdominal segments										Paddle	
	Cephalothorax	I	II	III	IV	V	VI	VII	VIII	IX		
0	—	—	—	—	—	—	—	—	—	—	—	—
1	1	7, 8 (8)	3-6 (4)	1	3-6 (4)	1	1-3 (2)	1	1	1	1, 2 (1)	—
2	1	1	1	1	1	2, 3 (2)	1	1	1	1	1	—
3	1	1-3 (1)	1, 2 (1)	4-6 (5)	2-4 (3)	1	1	1	1	1	—	—
4	1	3-7 (4)	1, 2 (1)	1, 2 (2)	1, 2 (1)	1, 2 (1)	1, 2 (1)	1	1	1	—	—
5	1	1-5 (?)	1-3 (2)	3-5 (?)	1-3 (2)	1, 2 (2)	1, 2 (2)	1	1	1	—	—
6	1	1	1	1, 2 (1)	1	1, 2 (1)	1, 2 (1)	1-4 (3)	1	1	—	—
7	1	1-3 (1)	1, 2 (1)	1-4 (2)	3-5 (4) q	1	1	1	1	1	—	—
8	1	—	—	1-6 (2, 3)	1-6 (1)	1-3 (2)	1-3 (2)	2-4 (3)	3-6 (5)	7-16 (8)	—	—
9	1	1, 2 (2)	1	1, 2 (1)	1	1	1	1	1	1	—	—
10	—	2-6 (6)	1-3 (?)	1, 2 (1)	1, 2 (1)	1	1	1	1	1	—	—
11	—	1, 2 (1)	—	1	1	1	1	1	1	1	—	—
12	1	—	—	—	—	—	—	—	—	—	—	—
14	—	—	—	1	1	1	1	1	1	1	—	—

1.17, emarginate at apex where setae are attached

Specimens studied are as follows: Yemen, Ta'izz, XII-1-51, 1 ♀, 1 ♂, PeLe, ex basin (K.L. Knight), Liberia, Roberts Field, no date, #43a, 1 ♂, PeLe, #33a,b, no date, 1 ♀, 1 ♂ (Gelfand); Senegal, M'bao, no date, #10257, 1 ♀, PeLe, ex polluted ditch.

KEY TO KNOWN PUPAE OF THE GENUS *LUTZIA*

- 1. Intersegmental membranes of abdominal segments II/III and III/IV reticulate; seta 3-II,III usually single; paddle emarginate apically (except in *Lt. shinonagai*) 2
- Intersegmental membranes of II/III and III/IV smooth, without reticulation; seta 3-II,III usually double; paddle straight apically (subgenus *Lutzia*) 5
- 2(1). Seta 5-II laterad of seta 4-II; postero-lateral corner of VIII not produced; seta 9-II-VI pointed at tip (subgenus *Insulalutzia*) *shinonagai*
- Seta 5-II mesad of seta 4-II; postero-lateral corner of VIII rather sharply produced; seta 9-II-VI blunt at tip (subgenus *Metalutzia*) 3
- 3(2). Seta 1-III, IV 0.5 or less length of following segment; seta 5-IV-VI shorter than following segment *trigripes*
- Seta 1-III, IV 0.7 length of following segment; seta 5-IV-VI longer than following tergum 4
- 4(3). Longest setae on abdominal segments IV-VI usually longer than following tergum *vorax*
- Longest setae on abdominal segments IV-VI usually shorter than following tergum *halifaxii, fuscana*
- 5(1). Seta 11-III,VII double or triple; trumpet without subapical expansion *allostigma*
- Seta 11-III,VII single; trumpet with subapical expansion, flared apically *bigoti*

KEY TO THE FOURTH INSTAR LARVAE OF THE GENUS *LUTZIA*

Since I had access to larval exuviae of the species of *Lutzia*, or to the descriptions of the larva of *Lt. shinonagai* and *Lt. vorax*, and since a key to all the species worldwide has never been produced, it seemed appropriate to include one in this work. Descriptions of the larvae for the New World may be found in Bonne and Bonne-Wepster

(1925), Senevet and Abonnenc (1939) and Lane (1953), and for the Old World, Bram (1967), Tanaka et al. (1979), Hopkins (1952).

- 1. Siphon index 3.0 or greater, setae shorter than width of siphon at point of attachment(subgenus *Lutzia*) 2
- Siphon index 2.0 or less, setae much longer than width of siphon at point of attachment(Old World species) 3
- 2(1). Pecten confined to basal 0.4 of siphon, usually 11 or more *allostigma*
- Pecten extending to 0.7 length of siphon usually 10 or fewer *bigoti*
- 3(1). Pecten closely spaced, confined to middle 0.3 of siphon; with 18-20 comb scales (subgenus *Insulalutzia*) *shinonagai*
- Pecten more widely spaced, extending to near apex of siphon, with more than 30 comb scales (subgenus *Metalutzia*) 4
- 4(3). Siphon with 10 or more pecten spines *tigripes*
- Siphon with 9 or fewer pecten spines *fuscana, halifaxii, vorax*

DIFFERENCES BETWEEN OLD WORLD AND NEW WORLD *LUTZIA* PUPAE

Intersegmental membranes.—The intersegmental membranes of the abdominal terga II/III, and/or III/IV have a definite reticular pattern in about the medial 0.15 in *Lt. fuscana*, *Lt. halifaxii*, *Lt. vorax* and *Lt. tigripes*, while *Lt. bigoti* and *Lt. allostigma* pupae have no such pattern, although a pigmented spot may be present medially on II/III.

Paddle.—Paddles of the New World pupae are longer and wider than those of the pupae of the Old World species. The *Lt. bigoti* and *Lt. allostigma* paddles combined measure 1.63-1.98, \bar{x} 1.78 mm long and 1.25-1.88, \bar{x} 1.55 mm wide and they are not emarginate apically. Paddles of *Lt. fuscana*, *Lt. halifaxii*, *Lt. vorax* and *Lt. tigripes* measure 1.19-1.56, \bar{x} 1.36 mm long and 0.96-1.36, \bar{x} 1.15 mm wide for the combined sizes of the three species. Data on *Lt. fuscana* and *Lt. halifaxii* given by Toma and Miyagi (1986) and Tanaka (2003) agree with these dimensions.

Seta 1-IX.—This seta is present in the

Old World species and absent in the New World taxa.

Larvae.—The larvae of Old and New World species are also quite different. *Lt. bigoti* and *Lt. allostigma* larvae have a siphon with an index of 3.0, a row of short, 6- to 14-branched, siphonal setae along the whole length while the larvae of *Lt. fuscana*, *Lt. halifaxii* and *Lt. tigripes* have siphon indices of 2.0 or less, a row of closely set, very long, single to triple setae, extending along most of its length.

It is quite obvious that the New World *Lutzia* immatures are morphologically very different from the Old World species, although the predatory behavior of the larvae remains the same. In the evolutionary process it is obvious that the isolation of the New World species has resulted in the development of significant morphological differences from the Old World species.

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